

Application No. 10/711,403  
Technology Center 1775  
Amendment dated April 18, 2006  
Reply to Office Action dated January 18, 2006]

**Amendments to the Specification:**

Please replace paragraph [Para 2] with the following amended paragraph:<sup>1</sup>

**[Para 2]** This is a continuation-in-part patent application of co-pending United States patent application Serial No. 10/065,054, filed September 13, 2002, now U.S. Patent No. 6,808,816.

Please replace paragraph [Para 5] with the following amended paragraph:

**[Para 5]** Thermal instability, or in the case of fuels, fuel instability, generally refers to the formation of undesired deposits that occurs when hydrocarbon fluids, such as fuels and lubricating oils, are at high temperatures, generally above about 140°C. ~~140°C.~~ In the case of fuels, it is generally accepted that there are two distinct mechanisms occurring within two overlapping temperature ranges. In the first mechanism, referred to as the coking process, a generally consistent increase in the rate of formation of coke deposits occurs above temperatures of about 650°F (about 345°C). ~~650°F (about 345°C).~~

---

<sup>1</sup> All references to pages and paragraphs in Applicant's electronically-filed application are those inserted by the USPTO authoring software.

Application No. 10/711,403  
Technology Center 1775  
Amendment dated April 18, 2006  
Reply to Office Action dated January 18, 2006]

Coke formation is the result of high levels of hydrocarbon pyrolysis, and eventually limits the usefulness of the fuel. A second mechanism primarily occurs at lower temperatures, generally in the range of about 220°F ~~220°F~~ to about 650°F (about 105°C to about 345°C), and involves oxidation reactions that lead to polymerization and carbonaceous gum deposits.

Please replace paragraph [Para 28] with the following amended paragraph:

**[Para 28]** The diffusion barrier layers 16 and 26 prevent interdiffusion between their platinum layers 18 and the article wall 12, which would occur at an unacceptable rate at the temperatures of concern for the invention. The barrier layer 16 also protects the wall 12 from chemical attack from contaminants in the fluid, such as sulfur and water that would form sulfuric acid and pit the surface of the wall 12. Therefore, with the protective barrier layer 16, the coating system 14 prevents or inhibits reactions between constituents of the fluid and wall 12. Preferred materials for the barrier layers 16 and 26 include ceramics such as silica (SiO<sub>2</sub>) and alumina (Al<sub>2</sub>O<sub>3</sub>), though other ceramics

Application No. 10/711,403  
Technology Center 1775  
Amendment dated April 18, 2006  
Reply to Office Action dated January 18, 2006]

could be used, including yttria ( $Y_2O_3$ ), hafnia ( $HfO_2$ ), tantala ( $Ta_2O_5$ ), mullite ( $3Al_2O_3 \cdot 2SiO_2$ ), and complex chemical combinations of silica with boron and/or phosphorous and/or alumina. As previously noted, the thicknesses of the barrier layers 16 and 26 must be sufficient to prevent interdiffusion with the material of the article wall 12. While optimal thicknesses will depend in part on the composition of the barrier layers 16 and 26, a suitable thickness range is about 500 to about 1500 nanometers, with a more preferred range being about 700 to about 1300 nanometers.

Please replace paragraph [Para 33] with the following amended paragraph:

**[Para 33]** A final evaluation was then performed to compare the performance of the coating system of this invention against different coating compositions. Deposition rates were again determined for twenty-five tube specimens formed of ~~formed of~~ Inconel 625, Inconel 718, 321SS or 347SS and under the same conditions as described above. Testing was performed on ten of each of the following specimens.

Application No. 10/711,403  
Technology Center 1775  
Amendment dated April 18, 2006  
Reply to Office Action dated January 18, 2006]

COATING MATERIALS	
SPECIMEN	(OUTER / BARRIER)
CBC-A	CVD tantala / CVD silica
CBC-B	CVD silica
CBC-C	CVD zirconia / CVD silica
CBC-D	CVD platinum / CVD silica

Coating thicknesses were about 150 to 200 nm for the outer layers (tantala, zirconia, platinum), and about 700 to 1300 nm for the barrier layers (silica). The total coating thicknesses of the all-silica CBC-B specimens were approximately the same as the coating thicknesses for the other specimens. As with the previous test, at the completion of about 150 hours, the amount of carbonaceous deposits was measured for each specimen relative to location along the lengths of the specimens. From Figure 3, it can be seen that very little deposition occurred on the specimens protected by the coating system of this invention (CBC-D). In contrast, those specimens coated with the other evaluated coatings experienced significantly higher deposition rates on specimen walls that sustained fuel temperatures of about 250°C to about 650°C.